

Development of a New NIST Calibration Service Using the Comparison Method for Vacuum Gauges Spanning the Range 0.65 Pa to 133 kPa

A new calibration service based on a secondary pressure transfer standard spanning this pressure range is being developed at NIST. It is designed to add a lower accuracy level service consistent with the needs of these customers and will follow a model where a less accurate, and less costly, service is offered to customers who do not require the lowest uncertainty available from NIST.

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Many NIST customers using our vacuum calibration services spanning the pressure range from 0.65 Pa to 133 kPa (5 millitorr to 1000 torr) desire direct traceability to NIST but cannot justify the cost of calibration against relative to the NIST Ultrasonic Interferometer Manometers (UIMs). These customers are typically using less accurate gauges, such as Thermal Conductivity Gauges (TCGs – see references below), or the newer combination type gauges that have 2 sensors combined with an electronic processor that averages or selects which sensor is being utilized depending on the pressure being sensed.

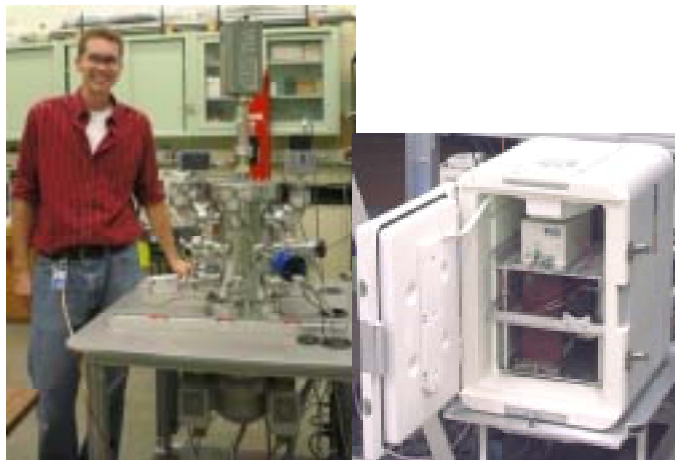
The Comparison Method Vacuum Gauge calibration service under development at NIST has been designed with the NIST calibration customer in mind. From the onset, the goals for this project were to reduce turn-around-time, calibration cost, and to provide an on-demand vacuum gauge calibration service. This new services is aimed at a class of pressure instruments whose accuracy capabilities are significantly less than that of the NIST standards currently used for calibration. Use of calibration standards consistent with the performance capabilities of this instrument class and utilizing extensive computer automation as part of the design concept consists of:

- A high-stability Transfer Standard Package (TSP) that provides traceability to NIST primary pressure standards and
- An automated test stand where the high-stability TSP and customer gauges can be compared with a series of computer-controlled pressure test points spanning the barometric pressure range of 0.65 Pa to 130 kPa.

At the core of the Comparison Method Vacuum Gauge calibration service is a NIST-designed, built, and tested TSP, consisting of two different gauge technologies: Resonant Silicon Gauges (RSGs) and Capacitance Diaphragm Gauges (CDGs). The RSG technology has dem-

onstrated superior long-term stability (drifting less than 0.01% per year) while the long-proven CDG technology provides superior low-pressure resolution at pressures below 133 Pa (1 torr). High-stability TSPs have been periodically calibrated against the NIST 160 kPa UIM and 140 Pa Oil UIM Primary Pressure Standards as part of our efforts in demonstrating the equivalence of NIST pressure standards relative to those of other nations. This TSP design has demonstrated excellent long-term accuracy with a considerable degree of robustness.

*In the figure, Jacob Ricker is standing next to the new NIST comparison method vacuum gauge calibration service test stand. To the right is the high-stability **Transfer Standard Package** that provides direct traceability to the NIST 160 kPa and 140 Pa Primary Pressure Standards.*



The Comparison Method Vacuum Gauge calibration service will meet the needs of NIST customers who require direct NIST traceability, reduce NIST vacuum gauge calibration cost and turn-around-time, while providing on-demand vacuum gauge calibration services.

The automated test stand has been developed using vacuum technology that will enable computer control of calibration fill pressures and data acquisition. Fill pressures spanning the range of 0.65 Pa to 133 kPa will be controlled

with a combination of a throttling gate valve (TGV) and a mass flow controller (MFC). The TGV and MFC are easily computer controlled enabling automation of calibration gas fill pressures. A Residual Gas Analyzer (RGA) mounted on the test chamber will enable rapid and leak-testing of customer gauges for quality control.

TGC References:

R. E. Ellefson, A. P. Miiller, J. Vac. Sci. Technol. A 18(5) pp. 2568-2577, 2000.
NIST Internal Calibration Report NC201.

Impact: This new service will offer service to customers who do not require the lowest uncertainty possible, enabling them to obtain a NIST calibration of less accurate vacuum gauges not currently calibrated at NIST, including TCGs, and new combination gauges employing multiple sensor technologies (TC, CDG, Piezoresistive, and RSG). The Comparison Method Vacuum Gauge Service is designed to have expanded uncertainties as low as 0.05 % from 1.33 kPa to 133 kPa (10 torr to 1000 torr) and 0.3 % from 1.33 Pa to 1.33 kPa (0.01 torr to 10 torr).